anthracite, ought not to rejoice in a pure and transparent atmosphere.

Similarly, the South Wales coal and iron districts would be centres of fog-clouds and mist, like Birmingham and Newcastle. But they are as free from fog as the purely pastoral valleys of Wales.

Next, as to persistency. Early in the morning of January 31 last, in some districts of London the fog extended considerably above the tops of the houses, in others only about 10 or 20 feet from the ground in any intensity. Where the fog extended high the smoke mixed with it and produced a yellow fog, but where it remained low the smoke escaped into the upper air and drifted away, leaving a white fog below, so pure as to be a very unusual phenomenon at 10 a.m. in a London street. Now it was remarkable, that wherever the white fog prevailed in the morning, the sun soon obtained the mastery and dispelled it more or less, but in the smoke-obscured districts a dark yellow fog continued throughout the day.

White fogs may doubtless be exceedingly dense. But will not an admixture of smoke increase its density?

A humid atmosphere is not necessary for the production of mist and haze. The frequent long-continued prevalence of blue haze over the whole country, not excepting the east coasts, in the driest east winds of spring, would be a subject deserving investigation. They sometimes extend to a height much above the tops of our highest mountains. Experiments such as those of Mr. Aitken will, we may hope, ultimately solve this problem of meteorology.

R. RUSSELL

Low Temperature

THE reading of the thermometer here last night, January 15, 16, was the lowest ever recorded at this observatory in the course of thirty three years. The reading was 4°·6 F., the previous minimum having occurred on December 24, 1860, when the mercury stood at 6°·7 F.

S. J. PERRY

Stonyhurst Observatory, January 16

A "Natural" Experiment in Polarised Light

BREAK off a plate of ice and hold it between the sky and a pool of water. Its reflected image will show the beautiful colours due to polarised light. The incident rays should come from a part of the sky about 90° from the sun, and reflection should take place at the polarising angle for water, and the plate will probably require adjusting to bring out the maximum effect. Water, vaporous, solid, and liquid, thus furnishes us with polariser, crystal, and analyser. I do not remember to have read any account of this very simple experiment, for which Nature provides all the materials.

CHAS. T. WHITMELL

9, Beech Grove, Harrogate, January 10

STATICS AND DYNAMICS OF SKATING

MANY years ago, when skating was but in its infancy, skates were made of bone, and if they could be made to stay on the feet they were considered to answer their purpose sufficiently well.

More recently iron runners with wooden beds came into use, and accuracy of adjustment on the foot, horizontally and longitudinally, was made easier by means of leather straps and a screw passing into the heel of the boot; and these adjustments, made haphazard, were quite sufficient for the skating of those days, namely forward skating.

Within the last twenty years however skating has made enormous strides, back skating becoming an essential qualification of a finished skater; and hence not only more perfect forms of skate are demanded from the maker, but also the adjustment of them on the boot becomes an important part of his duty.

There are three points to be attended to in the adjustment of the skate, besides the obvious one of placing the skate medially on the foot.

1. Height of foot off the ice where the greatest breadth of the sole of boot occurs.

2. Height of foot off ice at the heel.

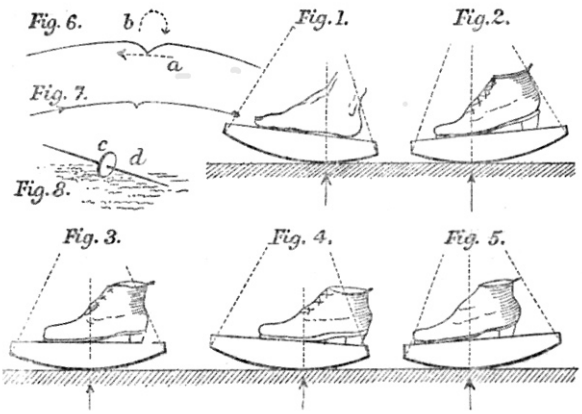
3. Position of the skate longitudinally or lengthwise on the foot.

First. The height of the foot from the ice should be such as will enable the skater to lean over sufficiently when on a curve, and such that he may be able to get a powerful enough stroke. If he is too low the edge of the boot will come in contact with the ice in leaning overt and also in taking a stroke: a fall ensuing in the firs, case, and a disagreeable and dangerous overstrain in the second. To avoid these the sole of the boot should subtend an angle at the bottom of the runner of about 96 deg. *i.e.* for a sole $3\frac{1}{2}$ inches broad the edge of the runner should be $1\frac{1}{2}$ inch from the sole, instead of varying from $1\frac{7}{8}$ to $1\frac{1}{8}$ inch, which are the heights of skates commonly met with.

This angle of 96 deg. will be found to clear the ice in both striking and leaning over for most skaters, and any greater height than is given by this angle should not be used, as it is not necessary, and only throws an additional strain on the ankle.

Second. The height at the sole having been fixed, the next point is what should be the height at the heel? In fact is the foot to be parallel to the skate, or is it to rest on an incline?

Dove was the first person, in his "Skater's Monitor," published in Edinburgh in 1846, to write on the position of the skate on the foot, summing up his remarks by saying, "Level woods then are for shoes whose heels



and soles are equally prominent, but high heels must be sunk into the skate-woods." This was quite correct at that time, when back skating was little practised, and when the skate which was then worn was made very flat, in fact almost straight at and near the heel. Now, by universal consent for figure-skating, the iron is made a segment of a single circle from toe to heel, $7\frac{1}{2}$ feet being the radius. Yet, notwithstanding these changes, Vandervell and Witham, as lately as January, 1880, in their "Figure Skating," recommend the very same parallelism of the foot to the skate instead of parallelism of the top of the blade to the ice, as it should be for modern skating, as I shall subsequently show.

In Fig. 1 is shown the result of adopting Dove's or Vandervell and Witham's position, *i.e.* no heel. It might be thought that a person standing on a curve would balance comfortably at the middle of the curve, but this cannot be, for a person standing naturally on a level surface does not distribute the weight of his body equally over the length of his foot, but by far the greater part comes on the heel, and therefore the centre of pressure of his body is nearer the heel than the toe, and consequently if he is standing on a curve the curve must roll up in front and down behind till the upward pressure of the ice just passes through the centre of pressure of his body. The point of contact of the skate on the ice will therefore not only be much behind the centre of the skate, but will be a little behind the centre of pressure of his body when standing on a level surface, as he now

rests on an incline. Of course the footstocks of the skates being too low behind would produce the same effect as too low a heel to the boot, *i.e.* throw the balance too far back.

Fig. 2 shows the position the skate will have on the ice if the heel is too high, *i.e.* the centre of pressure is thrown too far forward, and consequently the skate must roll up behind in order to get the proper balance.

In Fig. 3 is shown a skate in the proper position on the ice, *i.e.* with the heel raised so high as to throw the centre of pressure on the centre of the foot and skate.

The proper height of the heel of the boot to obtain this result will depend on whether the footstocks of the skates are level, as they ought to be, and the exact height will vary with different individuals, depending [on whether they naturally stoop or lean well back, and probably also on the boots they are in the habit of walking in, and therefore can only be determined accurately by trial; but a half-inch heel is by no means too low for most persons.

Third. With regard to the adjustment of the skate longitudinally, Figs. 4 and 5 will show the obvious effects of not fixing the skate properly on the foot; in Fig 4 the skate being put too far forward, and in Fig. 5 too far back.

Having now shown how to procure the balance on any desired part of the skate, it only remains to be shown why the [position of the skate, with the balance on the centre as in Fig. 3, is the proper one; and as the effects of the various positions are most evident in skating turns, I shall confine myself entirely to them, commencing by giving the theory of turns, which I believe has never been satisfactorily explained.

It is impossible in a few words to describe accurately and fully the forces which come into action in making a turn, but my object will be attained by describing what I consider the basis of the whole theory of turns, namely, that a turn is not a twist round of the body made by the skater at the moment of the turn, but the turning round of the body is the result of a reaction of the ice on the skater caused by his putting his skate (by rolling on to the toe or heel) in such a position as to make that part of the skate bite or grip the ice, producing a force opposite, though not directly opposed, to his direction of motion, but parallel to it. The direction of this reaction is shown by the arrow *a* in Fig. 6, and being exerted at some distance from the body, it necessarily tends to turn the body round in the direction of the arrow *b*. It will be evident that the greater the distance of the point of application of this force from the curve the skater is describing, the greater will be the *couple* tending to turn round the body.

This action can be shown by means of a disk of lead *c*, in Fig. 8, with a light rod through it. If this be made to roll on a table, and a force be applied to the rod at *d* by means of the finger, the action of reversing the body and preserving the same inclination will be distinctly shown. Suppose the skater then about to make a back turn, and that he balances near the heel of his skate as in Dove's plan, then, as he can only roll a very little further back, as he is already on the heel of his skate, the leverage, and hence the couple tending to turn him round, will be almost *nil*, the cusp he makes being of the shape shown in Fig. 7, instead of being of the shape shown in Fig. 6, and consequently if he is to turn round in time he must give his body a wrench round, which is of course very inelegant, and very difficult to accomplish. If the balance is on the heel the cusps of the forward turns are much larger than the cusps of the back turns, thereby tending to make the back turns more difficult than is necessary; but even with the balance on the centre of the skate back turns will be more difficult than forward turns, as the formation of our bodies prevents the bending up of the foot more than a few degrees, even with a boot off, whereas we can bend it down 40 deg. easily.

With the balance on the centre of the skate back turns can be performed without any wrench or swing of the leg—a thing that is physically impossible if the balance is on the heel, as it must be in Dove's or Vandervell and Witham's plan. CHARLES ALEX. STEVENSON

JOHN DUNCAN: THE ALFORD WEAVER AND BOTANIST

ON the last day of 1880 the University of Aberdeen was presented with a herbarium of 1131 specimens of the British Flora, gathered, preserved, named, and localised by an aged country weaver who lives near Alford in Aberdeenshire. He is no ordinary man, as the accumulation of such a botanical collection is alone sufficient to prove. It represents a portion only of the scientific labours of nearly fifty years—for much of these have been destroyed by time and the moth. This remarkable man, who is now a pauper on the parish which has been the scene of his unextinguishable scientific enthusiasm, should be better known to the scientific world, and a short sketch of his life and labours may not be unacceptable to the readers of NATURE.

John Duncan was born on December 24, 1794, so that he is now in his eighty-seventh year. His parents were very poor, and could afford him only the merest rudiments of even the three R's as then taught, for his education had to be sacrificed to the pressure of penury. He learnt to read by laboriously spelling his way through the text in church; his writing has ever been very rude, but distinct; and his spelling is such an example of the phonetic as would delight Mr. Pitman. He was early sent to work and became a "customer weaver," making into cloth the flax and wool sent to his home by his neighbours, and such he has remained ever since. He married early in life, and had a son and two daughters; but his wife died more than thirty years ago, and all his family have gone, he remaining as the sole survivor. During the greater part of his long life he has dwelt in the valley of the Don, near Alford, and for nearly thirty years in the same cottage at Droghsburn, in the pleasant hollow of the Leochel, five miles above that village. This cottage forms one end of a line of dwellings, the other belonging to a ditcher's family who prepare his simple meals. He occupies a single room, filled with the looms and other implements of his trade, open to the thatched roof, his bed resting on some deals laid across the rafters, and reached by means of a ladder. In this narrow space John Duncan has lived for twenty-eight years, a solitary man, in serene contentment, upright and religious, working laboriously for an honest living, cheered only by the friendship of a few, his love of books and his devotion to the study of plants, which he has prosecuted with a single-minded enthusiasm that is as rare as it is beautiful. I visited him about three years ago and spent two days in his company, having long wished to do so from what I had heard of him from his dearest friend and fellow student, Charles Black. I found him in good health, working hard at his craft with sturdy and admirable independence, visited only by a few disciples whom he had inspired with a love of himself and the plants, unknown, self-contained, and happy even on the verge of want. I examined his plants, talked of their history and the crowding memories they recalled of countless wanderings in their search, saw his books on botany, theology, and general literature, which are unusually numerous and costly for a poor man, conversed with him on many subjects, chiefly connected with his studies, and his intimacy with Charles, whose friendship is now the chief comfort of his age; and I left him charmed, inspired and rebuked by his life, character, enthusiasm and wise contentment, the result of unwearied devotion to higher pursuits.

Some interest in the solitary student was roused by an